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EDITORIAL NOTES

TWO MAJOR PROBLEMS

WE should be the last to cast emery into the wheels of war effort, but we cannot refrain from asking two questions at the present time. The first is whether gas undertakings throughout the country are, mindful of past promises and past exhortations, wholly satisfied with the coal situation. Whether, in fact, every undertaking is happy about its reserves of coal in face of possible difficulties in the near future and in the more distant winter. It is many months since gas undertakings were urged by the powers that be to lay in stocks of coal to outwit at least some of the enemy's manoeuvres; and we think we are correct in claiming that gas undertakings generally sought to achieve this object. Is the fault theirs if they have been unable to accomplish this obviously desirable aim? It goes without saying that export markets for coal have in several directions been temporarily lost. Therefore, we could argue, a glut of coal should exist in the country and that every gas-works, being forewarned and hence forearmed, should possess a plentiful supply of coal to meet normal and abnormal needs. Unfortunately this argument somehow falls to the ground when facts are observed, and we may well ask what is the root cause of the difficulty and query whether part at any rate is " behind the lines."

There must, of course, be remedy, and in this regard we have the recent recommendations of the Select Committee on National Expenditure—recommendations seeking to increase the production and improve the distribution of coal. The *Iron and Coal Trades Review* has had a good deal to say about the suggestions made, and has stated that central as well as regional action has been taken to secure the earlier release of wagons from sidings and for the removal of embargoes on consignments to particular destinations. The Secretary for Mines has expressed his intention to add 10 million tons to existing stocks. "Migration and conscription," remarked our contemporary, "have converted a labour surplus into a labour scarcity problem in the more important coalfields of the country, and the Secretary for Mines is backing the efforts of colliery owners and miners' leaders to prevent any further avoidable drain of manpower from the pits." For some time the Cabinet has been engaged in an effort to co-ordinate executive action by the Ministers responsible for maintaining coal supplies to essential industries. We think we are right in saying that transport delays constitute the heaviest handicap in regard to gas undertakings' coal stocks. Transport delays slow down the speed of the national war production effort and they cause waste of money.

We now come to our second question. Is all well with the tar situation in the Gas Industry? We have been given to understand that it is in the national interest to make the best use of crude tar, maybe by distillation and fractionation to supplant imported fuel oil and supply important products of a varied nature. Yet our observations lead us to believe that gas undertakings are accumulating stocks of tar which the present situation surely does not warrant. Tar oils are sold and bought under licence, and we may perhaps be forgiven for querying whether at the moment there is a bottle-neck, largely the outcome of red tape, between producer and distiller and user of this undoubtedly precious raw material. There is now, of course, an official go-between—not in this case a middleman in the ordinary sense. We hope and like to think that this official body will take a virile, active, view of the situation. We feel sure that the position will improve, and we are certainly not writing in pessimistic vein. The problem will be solved by co-operation, by mutual understanding of the difficulties involved and by the active development of new markets. And we know full well that the Gas Industry is anxious and willing to pull its full weight in any co-operative measure designed to smooth the way.

A CHALLENGE

THE President of the American Gas Association, Mr. Thomas J. Strickler, has sent out a challenge to the American Gas Industry of to-morrow. America, he said, does not face a crisis, which smacks too much of a spirit of defeatism; it does face a challenge. Having remarked that under normal conditions the principal concern of business is to maintain and develop established markets, he went on to express the hope that this policy will remain a dominant factor in business under the national defence programme, even though normal markets and distribution methods may undergo some temporary dislocations. No industry is more vitally important in any programme of national defence than is the Gas Industry. The basis of all war preparations is heat, and no other form of heat can equal gas fuel for its flexibility, ease of control, and efficiency.

We quote the President of the A.G.A.: "Two tasks face us, and we dare not fail in meeting both of them adequately. One is the ability of our Industry to assume the heavy industrial work of assisting in turning out the manifold implements of war. The other is to make sure that the service we render to millions of American homes will be maintained at a high rate of efficiency. In a time of emergency such as we are now witnessing the duty of sustaining the morale of the nation is one of surpassing importance. The two go hand in hand—national defence and a smoothly running economic machine. One job cannot be done well without the other. Therein lies our double obligation." In our own country the vital part which continuous gas supply plays in sustaining public morale and in maintaining public health at a high standard has been proved amply enough amid the shocks of modern aerial warfare. It was only a fortnight ago that we had the opportunity of remarking on public recognition of Gas Industry services and public appreciation of the manner in which the Industry has organized itself on a co-operative basis to ensure as far as humanly possible continuity of supply under the most adverse conditions.

Certainly the American Gas Industry enters into the new effort fully fitted as a basic fuel industry to meet the vast industrial heating needs of factories and mills that are producing the thousands of parts for equipment and machines necessary in a period of war economy. In the hardening of small and intricate parts of machine guns to the final heat treatment of the largest guns, specially designed gas furnaces are speeding production on an ever increasing basis. In the navy yards some of the largest industrial furnaces ever built are annealing fully assembled gun turrets with gas. Equipment which has been developed for peacetime use during the last decade through co-operative research and engineering by the gas undertakings and leading manufacturers under the sponsorship of the American Gas Association is rapidly being put to work to speed up production in war industries.

Wartime Sales Procedure

Under the auspices of the Greater London Gas and Electricity Committee a Wartime Sales Procedure has recently been adopted by eight gas undertakings in the London Regional Gas Centre, and 47 electricity undertakings in the Greater London area of the British Electrical Development Association. The Procedure, which implements the January, 1940, Report and recommendations of the National Joint Gas and Electricity Committee, deals *inter alia* with publicity and propaganda; restrictions on certain canvassing; cessation of payment of commissions to Agents for the preferment of either industry; policy in dealing with new consumers and changes of tenancy; and the installation of apparatus in new premises, &c. The agreed Wartime Sales Procedure does not interfere with fundamental trading practice; at the same time it is designed to avoid, as far as possible, any action that might—even in a small degree—prove a hindrance to the nation's effort at the present time. At the last meeting of the Committee it was agreed to extend the area to cover the whole of the "London Region," comprising 15 gas undertakings and 62 electricity undertakings. Steps are now being taken to secure acceptance of the Procedure by the additional undertakings. The Joint Secretaries of the Greater London Gas and Electricity Committee are: Mr. L. H. Hardern, London Regional Gas Centre, Church Street, Kensington, London, W. 8, and Mr. V. W. Dale, British Electrical Development Association, Inc., 2, Savoy Hill, London, W.C. 2.

X-Ray Analysis in Industry

The earliest application of X-ray analysis was to the determination of the atomic arrangement in crystalline structures, and this work has had far-reaching results in many branches of science. Of recent years this powerful tool of the physicist has been used to investigate many other characteristics of the solid state, such as the identification of crystalline constituents of minute samples, the structure of alloys, the identification of intermediate products in chemical processes, the identification of allotropic changes in refractories, and the determination of sub-microscopic crystal size and orientation. A new field, hardly explored at all as yet, is that of the sub-microscopic structures within each individual crystal, such as occur in age-hardening and other types of imperfect phase precipitation in the solid state. Such structures profoundly influence physical properties and hence are of great interest. The importance of this subject, particularly for the present war effort, has led to a widely expressed desire for closer collaboration and sharing of experience between those concerned with the subject. This desire is being met by the publication of a series of Papers invited by Sir Lawrence Bragg, President of the Institute of Physics and a pioneer in this field, and will be published by the Institute in two special issues of the *Journal of Scientific Instruments*. The first group of Papers will be published in the May issue and will deal with the applications of X-ray methods as applied to a wide range of industrial problems.

Personal

Mr. H. D. Madden's Services Honoured

Following upon the annual meetings of the District Boards of the National Gas Council and the Federation of Gas Employers in Cardiff, on April 24, a large assembly met at a complimentary luncheon to Mr. H. D. Madden, M.Inst.C.E., Cardiff, whose retirement from the position of Engineer and Manager with the Cardiff Gas Light & Coke Company was announced in the "JOURNAL" last week.

The gathering was thoroughly representative of Mr. Madden's friends and colleagues in all branches of the Gas Industry in South Wales, and in addition there was a large number of expressions of regret of inability to attend.

The luncheon was the occasion of the presentation of a testimonial to Mr. Madden, subscribed for by members of the Wales and Monmouthshire Association of Gas Engineers and Managers and other representative bodies in the district. It consisted of a handsome selection of Georgian design silver plate, a King George I silver tankard, and a substantial cheque.

In the absence of Mr. J. Herbert Canning, O.B.E., J.P., who was regrettably unable to be present through indisposition, the chair was taken by Mr. J. Prosser Jones, J.P., of the United Kingdom Gas Corporation, Ltd., Vice-Chairman of the South Wales Executive Board of the National Gas Council. The Central Executive Board was represented by Mr. W. J. Smith, Secretary of the National Gas Council. The Cardiff Gas Company was represented by Mr. Robert H. Williams, J.P. (Chairman), together with several of his colleagues on the Board.

The presentation was made by Alderman Sir Charles H. Bird, C.B.E., J.P. (South Wales Tar Distillers). Sir Charles said that the outstanding services rendered to the Gas Industry by Mr. Madden were that day reflected in and acknowledged by the large gathering which had come together to pay tribute. He proceeded to review the many directions in which Mr. Madden had placed those services at the disposal of the national organizations, not only in the District but throughout the country, and to the personal benefit of his colleagues since he came to Cardiff in 1906, and especially as Engineer and Manager from 1923.

A number of subsequent speakers paid similar tribute to Mr. Madden's outstanding record of work, not only for his own Company, but also in his co-operation and readiness to assist the work of the Industry in the District, where his leadership had been of the greatest value, particularly to the smaller undertakings, who had largely benefited thereby. Each and every one bore testimony to Mr. Madden's friendly disposition and ready co-operation.

The speakers included Mr. Robert H. Williams (Chairman of the Cardiff Company), Mr. W. J. Smith (Secretary of the National Gas Council), Mr. R. J. Auckland (District Secretary of the Federation of Gas Employers), Mr. R. L. Aspinall (President of the Wales and Monmouthshire Association of Gas Engineers and Managers), Mr. W. Clark Jackson (District Secretary of the National Gas Council), Mr. W. H. Johns (Swansea), Mr. E. M. Edwards (Port Talbot), and Mr. Evan Rees (Public Relations Officers of the Wandsworth Gas Company).

Returning thanks, Mr. Madden expressed his appreciation of the many evidences of friendship and regard which he had received that day from so many directions. In particular he had been deeply touched by a further presentation received that morning of a gold fountain pen from his personal staff.

He made reference to his Directors' willingness at all times to co-operate with him to the utmost in the District organizations. Such services as he had been able to perform in this direction had been possible through that co-operation and that of his colleagues and his own staff. It was a source of gratification to him that the petition for the Royal Charter of The Institution of Gas Engineers had been presented during his Presidency, and that as a consequence his name came first among the petitioners for the Charter, which was in their proud possession. He also referred with deep appreciation to the action of the Executive Committee of the National Gas Council in making him an Honorary Member of that Committee, and he was deeply gratified that the services which he had been able to render had been so signally recognized. He paid a tribute of high appreciation for the help and guidance he had always received from Sir David Milne Watson, Chairman of the National Gas Council and Governor of the Gas Light & Coke Company.

Mr. F. Dawson

A large representative gathering of the employees of the Herne Bay Gas Company assembled at the Company's Sports and Social Club headquarters, on Wednesday, March 26, to present a farewell gift to Mr. F. Dawson, former Engineer and Manager and now Engineer and Manager of the Folkestone Gas Company. Mr. E. F. Smallbone, who succeeded Mr. Dawson as Engineer and Manager at Herne Bay, presided.

Mr. Arthur Wells, Works Manager, said they had met to congratulate Mr. Dawson on his new appointment, and to wish him every success. Mr. Dawson had been in Herne Bay four years, and during that time considerable progress had been made.

Mr. G. S. Wareham, Secretary of the Company, said that he wished to be associated with the remarks that had been made. He had worked in close collaboration with Mr. Dawson and had thoroughly enjoyed doing so.

The Chairman then called upon Mr. C. Brett, one of the oldest employees, to hand to Mr. Dawson a small present which took the form of a Ravallo razor. Miss C. Norwood of the Office Staff handed him a small present for Mrs. Dawson.

In acknowledging the gifts Mr. Dawson said that his four years with the Company were some of the happiest of his life. Everyone that he had met had contributed to that, and he was very sorry for that reason to have to leave the district.

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Mr. WILLIAM SUTCLIFFE, B.Sc., who, as we reported on April 23, has succeeded Mr. Eadington as Engineer of the Blyth Gas Company (Newcastle-upon-Tyne and Gateshead Gas Company), had been Assistant Engineer at Blyth since August, 1940. He began work in the Gas Industry as Junior Chemist at North Shields in 1929, and his degree in Pure Science was conferred at Durham University in 1933. He was then appointed Shift Engineer at the Elswick Works of the Newcastle Company. In the winter months of 1935–37, Mr. Sutcliffe acted as Assistant Manager at this Company's North Shields Works, and in 1939–40 he was in a similar position at their Redheugh Works, Gateshead.

* * *

Mr. T. N. F. SMITH and Mr. C. WALLS have been elected to the Directorial Staff of Messrs. Thomas Smith & Sons (Rodley), Ltd.

Both have been long and closely associated with the firm, Mr. Smith being the son of Mr. F. H. Smith, the Joint Managing Director, and Mr. Walls having been for the past 20 years General Manager of the Company.

Gas Light & Coke Company

The postponed Annual General Meeting of the Gas Light & Coke Company was held on April 24 at Gas Industry House, Sir David Milne-Watson presiding.

The retiring Directors, Sir Harold Hartley and Viscount Mersey, were re-elected, and the retiring Auditors, Mr. P. H. Ashworth and Mr. H. E. Ibbs, were reappointed. No dividend was declared on the Preference, Ordinary and Maximum Stocks of the Company for the half-year ended Dec. 31, 1940.

Obituary

F. S. Cripps

Mr. Frederick Southwell Cripps, Assoc.M.Inst.C.E., died at Worthing on April 19 at the age of 85 years.

Born at Worthing in 1855, he rose to eminence in his profession as Consulting Engineer to gas and water companies. He was an authority on the construction of gasholders, and his book, *Guide Framing of Gasholders*, became a standard work and was translated into Dutch at the request of the authorities in Holland. Another of his important Papers was "An Investigation into the Strains upon the Top Curb of a Gasholder."

Mr. Cripps commenced his career as pupil to Messrs. J. & A. Blythe, Marine and General Engineering, London, in 1873. He passed through shops and offices, spending all his spare time in the study of engineering sciences. After leaving Messrs. Blythe, he entered Messrs. Cutlers' Drawing Office for a little more than 12 months, and from there entered the city office of Messrs. C. & W. Walker. Shortly afterwards he went to their works at Donnington, Shropshire, and remained until 1879, when he passed a short term in the Sutton Gas-Works.

He was induced to start on his own account as a Consulting Engineer to gas companies in 1880, and he acquired offices in Westminster. He built the largest gas-holder of its time in the world, and thirty years ago, as Consulting Engineer to the Bournemouth Gas and Water Company, he built what was up to then the cheapest gasholder in the world. He was also Consulting Engineer to the Bournemouth Corporation, and provided the town with its water supply from Wimborne.

Mr. Cripps retired from his profession in 1914, and died a bachelor.

Letter to the Editor

Scottish Gas Undertakings' A.R.P. Organization

SIR,—According to the report in the "GAS JOURNAL" of the North British Association of Gas Managers held in Glasgow, the President, Mr. R. D. Keillor, stated that the first practical scheme suitable for general application had been drawn up and made available through the medium of the Commercial Sections of the Association.

Without wishing to raise minor points upon a most important subject of vital service to the Gas Industry, it seems only fair to correct the statement to the facts and place the credit where it is due.

At the request of the Fife County Council a meeting of representatives of Fife Gas Undertakings was held in Kirkcaldy on Jan. 16, 1939, at which a small Committee headed by Mr. Jas. J. Scott, Cowdenbeath, was appointed to organize A.R.P. for all undertakings in the County. As a result of their work a Mutual Aid Scheme was developed, the undertakings being similarly grouped with a Group Leader, a record of all spares, tools, equipment, and repair squads being organized and the whole harnessed into the County Schemes for assistance in respect of Ambulance, First Aid, Fire Fighting, Communications, &c.

The scheme was in complete operation by Aug. 8, 1939. On Sept. 13, 1939, the Western District Commercial Section first took up consideration of the matter, followed by the Waverley Commercial Section on Nov. 23, 1939, and by the North Eastern Commercial Section in March, 1940.

Early in December, 1940, the Commission for Scotland appointed Mr. James Jamieson, Edinburgh, to act as Regional Gas Engineering Adviser for Scotland, the several schemes above referred to were examined, and the Fife Scheme was determined the most satisfactory and was adopted in principle for Scotland.

The Fife area is now part of the East of Scotland District under the care of Mr. John Wilson, Dundee, as District Adviser, whom it is supporting with every possible effort.

Yours, &c.,
"FIFER."

April 21, 1941.

Wandsworth and District Gas Company

The Annual General Meeting of the proprietors of the Wandsworth and District Gas Company was held on April 22 at the Chief Offices, Fairfield Street, Wandsworth, S.W. 18.

It was agreed that the dividends for the six months ended Dec. 31, 1940, should be paid on April 23 at the following rates: On the 4% Preference Stock at the rate of 4% per annum; on the Consolidated Stock at the rate of 4% per annum (less Income Tax).

Messrs. B. R. Green, J. B. Brown, and E. M. Wood were re-elected to the Board of Directors.

Mr. Bernard Hennell was re-elected as an Auditor of the Company, and it was agreed that the remuneration of the Auditors should be increased by £100 per annum.

The Chairman, Mr. Frank H. Jones, proposed a vote of thanks to the Staff for their loyalty in carrying out their arduous duties in an excellent manner under difficult conditions. This was carried with acclamation.

The proceedings terminated with an expression of thanks and appreciation to the Chairman and Directors for their able management of the Undertaking.

Institution of Gas Engineers

The following meetings have been provisionally arranged to take place in May and June. Attention is drawn to the alterations in the date and times, as previously fixed, of the meetings of the Finance and Membership Committees and of the Council.

Tuesday, May 6, 12 noon, Finance Committee ; 1.45 p.m., Joint Meeting of Finance Committees of the Institution and of the Gas Research Board ; 2.15 p.m., Membership Committee ; 3 p.m., Council.

Tuesday, May 20, 2 p.m., Gas Education Executive Committee.

Tuesday, June 17, 2 p.m., Gas Education Executive Committee.

Provisional arrangements are being made to hold the 78th Annual General Meeting, circumstances permitting, on Wednesday, June 11, in London.

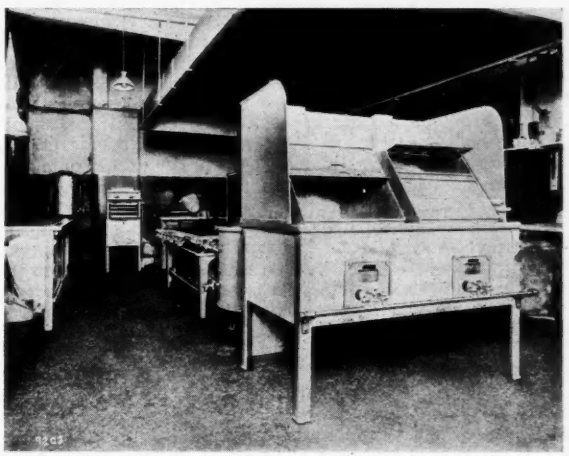
The Written Examinations of the Institution will be held throughout the country on June 14 in Gas Engineering (Manufacture), and on June 21 in Gas Engineering (Supply).

Members of The Institution of Gas Engineers will be welcome at a Joint Meeting of the Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry to be held on Tuesday, May 13, at 2.30 p.m. in the Rooms of the Geological Society, Burlington House, Piccadilly, London, W. 1, when a Paper on "Economical Raising of Steam in Small and Medium-size Boiler Plants" will be presented by Dr. G. W. Himus.

An informal luncheon will be held prior to the meeting at 12.45 p.m. for 1 p.m. at Stewart's Restaurant (corner of Piccadilly and Old Bond Street). The cost, exclusive of wines, will be 3s. 6d. per head, to be paid at the tables. In order to enable adequate arrangements to be made, those intending to be present at this luncheon should notify the Joint Honorary Secretaries, Institution of Chemical Engineers, 56, Victoria Street, London, S.W. 1, not later than Monday morning, May 12, 1941.

Members of the Institution who are members of either the Institution of Chemical Engineers or the Chemical Engineering Group do not require tickets for the meeting, but non-members should obtain tickets.

Works Canteen for 500 People



Fletcher, Russell & Co., Ltd. (Radiation), were recently entrusted with the installation of a complete new kitchen for a works canteen catering for 500 persons. The photograph shows a corner of the finished kitchen. The whole of the cooking apparatus is in "Radar" mottled enamel finish. Subsidiary equipment and labour-saving devices comprising sinks, drainers, plate-racks, tabling, cupboards, refrigerator, potato-peeler, and chipping machine were all included in the scheme. The management state that all the equipment is working to the utmost capacity, and is giving every satisfaction.

South Metropolitan Gas Company

The Ordinary General Meeting of the South Metropolitan Gas Company was held at the Vauxhall Works of the Company on April 16, Mr. Frank H. Jones (President of the Company) in the Chair.

Dr. E. F. Armstrong, F.R.S., and Colonel A. B. Pasmore, the retiring Directors, were re-elected. The retiring Auditor, Mr. F. J. Bradfield, F.C.I.S., was also re-elected, and Mr. Bernard Hennell, F.C.A., was elected an Auditor in succession to Mr. C. P. Crookenden, F.C.A., who has found it necessary to curtail his professional engagements. No dividend on the Preference Stocks for the second half of 1940 nor final dividend on the Ordinary Stock was declared.

At the Ordinary General Meeting of the Montevideo Gas & Dry Dock Company, Ltd., to be held on May 20, the Directors will recommend payment of a final dividend of 3% free of income tax, 2% of which payable on May 21 and 1% on Dec. 1, making with the interim dividend of 1% paid Dec. 2, 1940, 4% free of income tax for the year ended Dec. 31, 1940.

POST-WAR RECONSTRUCTION

A GAS ENGINEER LOOKS FORWARD

IT is permissible at times for even the busy gas engineer to-day, in his intervals of standing by to deal with possible emergencies, to reflect on what is likely to be the nature of the post-war problems and opportunities of his Industry. As an engineer whose works have not yet felt the blast of war, the writer has found leisure to think upon these problems and now proposes to think aloud, as it were, in order to stimulate discussion. It would be futile in any industry to begin to make firm plans for developments after the war, until more pressing immediate problems have been dealt with. We are not yet sufficiently near the end of the war, in appearance at any rate, to be able to forecast what will be the probable conditions of the country physically and financially. We are still in the blackout in this respect. We know enough, however, already to be able to forecast that a return to the pre-war conditions will be unthinkable, and that when—

> " Night's candles are burned out, and jocund day
> Stands tip-toe on the misty mountain's tops "

we shall have to reconstruct our national life and the conditions under which we live in such a way as to meet the fundamental fact that this once wealthy nation will be for a time impoverished, and that this impoverishment will to a large extent be shared by the whole world.

There are two ways of meeting such a condition. One is by drastic retrenchment; and that too often is the method by which individual firms and industries meet an emergency of this character. The other is by a bold policy which, while cutting out all unnecessary expenditure, nevertheless enables projects to be undertaken which, in course of time, when properly handled, will yield a rich harvest. The writer well remembers learning a lesson on this subject from a misfortune which befell a friend. He was a Director of a good business not connected with the Gas Industry. During the depression of ten years ago business had shrunk to vanishing point, and as a result this man agreed to leave the firm. In such circumstances most people would have met the situation by drastic cuts in private expenditure until financial stability had once more been obtained. What this man said, however, was: "I have been living at the rate of £1,000 a year, and I shall not reduce my standard of living. I shall immediately take another office and set up in business, and I shall re-establish myself by other undertakings." In this project he was entirely successful. That appears to the writer to be the spirit with which this country must meet its post-war problems. There is a proverb which reads, "The morning hour has gold in its mouth," and "when the black bat night has flown" it will be our task to find this gold.

The method by which we must proceed is clearly indicated by the industrial history of the past two centuries. We must take advantage of every advance that is made by the work of engineers, chemists, economists, and business men. The gates of science lie open before us and we must take every advantage of the riches that science can provide. Many of those riches can be had for the asking if we would but know how to apply them; others require hard work and perhaps a good deal of expenditure in development before we can make use of them. It cannot be said that the Gas Industry has lagged behind in undertaking research work within recent years, but the Industry as a whole has been lacking in the application of research. The Gas Industry is conservative above all else. It possesses what the late Sir William Watson described as "the staid, conservative, came-over-with-the-Conqueror type of mind." The average gas engineer is a good fellow, but he is an engineer or a manager first, and a gas technologist last. He has his problems of management of his undertaking which of necessity crowd out the vision of opportunities which can only be secured by a far-sighted policy of grasping and utilizing the results of scientific research. Often he is too busy to read the scientific reports of his fellows in the Industry and usually, because he is too busy or because of the conservatism of his Board, he is unable to apply them.

The ability to apply the results of scientific research is a somewhat rare accomplishment, and quite often the progress of an invention shows that even those who would be expected to possess this accomplishment fail at times in a quite remarkable manner. Sir Richard Gregory has described how he was present in London in 1884 when Hertz demonstrated before an audience of the principal physicists of his day that electric waves could be generated at one corner of the room and detected at the farthest corner, the current having been passed through the intervening space without a wire; no one in all that audience then saw any practical possibility in what was to them nothing but an interesting experiment, and it was not until 1894 that Sir Oliver Lodge first demonstrated that these waves could be used for signalling, and shortly after this Marconi commenced his experiments and took out the first patent for radio-telegraphy.

This and other examples which readily come to mind have a practical lesson, which is that when the Gas Industry re-organizes itself after the war and appoints a Director of Research, he must not be only a man of eminent scientific attainment; he must not be a man of conservative views brought up in the Gas Industry, but he must be chosen as having the flair for the application of research. And because he must inevitably miss some of the implications of his work, there must be a Committee of gas technologists of active mind and vivid imagination whose work it must be to endeavour to find applications and to assist the Director with advice at all times.

If stress has been so far placed upon research work and the development of new methods of manufacturing and utilizing gas, it must not be assumed that this is the only direction in which the Gas Industry can progress. The structure of the business world to-day is markedly different from that of 1914. Business men have advanced in their methods of business organization. The "research" work for this was perhaps not consciously undertaken, but the results emerged from the crucible of the last war and its aftermath, and can be clearly seen to-day by anyone who knows the structure of industry both in this country and throughout the world. Vested interests must not be allowed to prevent the Gas Industry from taking advantage of what has been learnt in this direction.

This brings us more directly to a consideration of the scope and organization of the post-war Gas Industry. We have to discover in the first place what should be the scope of the Industry, and here we shall find very divergent views. The Gas Industry has hitherto for over a century been content to be a branch of the carbonizing industry. It has carbonized coal and produced coke and by-products. It has converted part of the coke into water gas. It has sold gas and coke. Some large works have distilled their tar and have worked up their ammonia into sulphate; others have sold the by-products in the crude state. Much the same conditions have arisen in regard to benzole disposal. There has arisen, therefore, a tar distillation industry which has taken the tar products from the smaller works, while the larger undertakings have also developed by-product works of considerable magnitude. The Gas Industry has thus moved towards the chemical industry. Of recent years the necessity of meeting competition has encouraged the Industry to set up a sales organization of a character hardly conceivable in the opening years of the century. There are Industrial Gas Centres at which highly skilled technical and scientific staffs are available to assist other industries in utilizing gas for industrial processes. There are great firms engaged in the manufacture of gas appliances who also have their research staffs continually endeavouring to improve these appliances.

Throughout all this there runs one common thread—namely, that research and development work can only be undertaken by the large concerns, and that in many instances a number of smaller concerns have grouped themselves together in order to set up the necessary development department or Research Association. In modern industry the day of the small isolated undertaking is passing. In the disposal of coke, whole regions have joined to form Coke Associations which are performing, and will increasingly perform, the same service for coke as other organizations are performing for gas. The Gas Industry is very much more highly organized to-day than it was thirty or forty years ago.

But what has been pointed out earlier must not be forgotten—namely, that the great majority of gas engineers are not easily able, for a variety of reasons, either to see the application to their works of new ideas, or to apply this application when it has been understood. If the Gas Industry as a whole is to progress, it must not be left to the individual gas undertaking to use its own discretion as to whether a particular process or method should be adopted, whether a particular organization should be joined, or whether particular policies should be accepted. There must be some central authority having a

wider knowledge and experience than the individual gas manager who is able to decide these matters for the smaller undertakings. This does not mean that local conditions must not be taken into account, because to neglect to do this would be fatal. A properly staffed central organization would contain men well able to consider these local conditions before deciding that any particular plant, process, or policy should be adopted by the constituent works.

There is a great deal to be said in favour of the measures proposed by the P.E.P. Report on the Gas Industry which was published two years ago. This Report foreshadowed the conception of the Gas Industry as a unified whole, organized regionally in such a way—

(1) That the original initiative towards reorganization comes from a national body which must formulate certain general, geographical, technical, and commercial principles of policy, and stimulate progress on the lines laid down.

(2) Within this framework the maximum of responsibility would be left to regional groups, as the operating units.

(3) Contact with the consumer would remain with the smaller local unit within the group.

It is suggested that the central body, to be responsible for the development of the industry, should be called National Gas Authority. Its main functions would be:

(1) To promote the grouping of undertakings within gas supply regions, defined by means of an initial survey, which might be carried out by regional commissions.

(2) Through the regional groups to promote the rationalization of production and co-ordination of technical policy on the basis of evidence obtained in the survey.

(3) To supervise nationally the marketing of coke; and to co-ordinate and extend national policies with regard to the marketing of other by-products.

(4) To guide the general line of commercial policy in the industry as a whole.

(5) To collect information and give advice on economic problems affecting the Industry.

(6) To be responsible for the public relations of the Industry.

(7) To put forward schemes for recruitment and training of personnel.

The need for higher standards of personnel is partly an inevitable consequence of the existence of very small undertakings where one or two men are called upon to perform a great number of duties which require special training. Partly, also, it is due to lack of a sufficiently vigorous recruiting policy in the Industry. Grouping of undertakings and co-operative effort can alone remedy the first fault, by making possible the employment of specialist staff whose services will be spread over the operation of several at present independent undertakings. With regard to recruitment there is a distinction, though not clear cut, between the recruitment and training of the lower grades of technical and sales staff and the filling of important technical and administrative posts. As to the former, the extension of co-operative training and apprenticeship schemes would go far to meet the need. As to the latter, more attention should be paid nationally to the sources of good material. There are many methods of recruitment—by establishment of grants and scholarships and co-operation with educational authorities. Above all, the prestige of the Industry must be high and the prospects attractive if results are to be obtained. There is strong competition for the best personnel in all ranks of industry to-day, and it is essential for the Gas Industry to obtain its fair share.

In its working shape the proposed reorganization of the industry would involve—

(1) The small local unit—either a separate undertaking or a branch whose main responsibility would be for local contact with consumers, including sales, installation n aintenance, and service work.

(2) The regional group, which might be either ı co-operative body or an amalgamation, planning production for the region as a whole, arranging where necessary for bulk supply and the extension and closing of works, providing common services of a technical or specialized nature, and directing marketing and bulk purchases of appliances within the region.

(3) The National Gas Authority constituted from existing national organizations within the industry, including the appliance makers, supervising and co-ordinating the operations of regional groups, providing certain central services, and conducting the relations of the Industry with the public in general, the State, and other industries.

(4) Gas Commissioners administering the system of ultimate control in the interests of the consumer, under Parliamentary supervision, which is now administered by the Board of Trade.

Once the Gas Industry has been organized in such a way as to work as a concerted whole and with a unified policy, it can be considered in what direction it should then move. It can well be imagined that the conception of the Gas Industry might well follow somewhat analogous lines to that of the chemical industry as exemplified by Imperial Chemical Industries, Ltd. There we have a number of constituent firms all following the policy of the central Board, but all otherwise working individually. Future developments within the Gas Industry would be very much simplified if a similar organization could be set up. It would then be possible to adopt much wider policies of gas utilization than are possible to-day.

(To be continued in a forthcoming issue)

Our Local Government*

While it is, perhaps, reasonable to suppose that only those who have themselves accomplished the task will be able fully to appreciate the difficulties in the way of continuing under wartime conditions the publication of anything in the nature of a comprehensive up-to-date directory, in some measure these difficulties must be obvious to all. Thus both compilers and publishers are assured of general congratulation on the production in the complete form in which it appears of the 1941 edition of the *Municipal Year Book*. The volume, indeed, provides irrefragable evidence of both determination and ability on the part of the *Municipal Journal*, whose service to Local Government is so well rendered.

All this would be true were the book solely a directory and compilation of statistics, but in fact it is much more than this. The first section of the new edition consists of a comprehensive review of Local Government in 1940, with emphasis on the civil defence services, and traces the outstanding developments and the effect of the war on the various civic services. In the sections dealing with the different services—including Section 13, which deals with Gas Supply—prominence is given to the effect of new legislation and of Rules, Orders, Regulations, &c., as a result of wartime conditions. The provisions of the Gas Regulation and of the Gas Undertakings Acts are summarized. The effect of the year of war upon gas undertakings is touched upon, and it is remarked that, in spite of all difficulties, the Gas Industry has maintained its position as a pre-eminent fuel industry. An outline of the Industry's activities is given, to show that it quickly and successfully adapted itself to wartime conditions. A new section of the volume this year—again an indication of new problems introduced by the war conditions of to-day—is that devoted to salvage; while one of the most comprehensive sections is that dealing with air raid precautions and the fire brigade service.

Street Lighting Contracts and the War

In Section 11—that which relates to Street Lighting—there are some useful remarks upon the general position of agreements on this subject. The suspension of ordinary street lighting brought about by the war, while it stopped all normal development, introduced many problems of its own; problems similar to those that arose during the last war, and which, it is remarked, "surprisingly few Lighting Authorities or contracting undertakings had the foresight to provide for in the event of an outbreak of war during the term of subsequent contracts." Alas, this is but one of many ways in which we have suffered, and are suffering, through the refusal to believe that "the war to end war" had not, indeed, realized this aim. When the present world conflict has drawn through all its terrible stages to a close, what will be the attitude of Lighting Authorities and contracting undertakings towards their public lighting agreements? What will foresight dictate for inclusion in subsequent contracts? One may hope—and, indeed, expect—that there will be overwhelming justification for far greater optimism than was warranted in 1918. But, after all, one additional "providing" clause in an agreement is not a very onerous undertaking. However this may be, it is pleasing to gather from the Year Book that on the present occasion a large number of Lighting Authorities and their contracting undertakings have already come to amicable agreements to span the period during which normal lighting is suspended, and that, while there are, of course, definite legal obligations to be taken into consideration, "by far the greater number of authorities and undertakings have shown a commendable spirit of compromise in settling matters in a mutually satisfactory manner." The basis upon which many equitable wartime street lighting arrangements have been made is outlined.

The directory part of the volume gives details concerning Government departments, and lists of members and chief officers of local governing bodies. Full addresses are furnished, and also telephone numbers, and whenever necessary temporary wartime addresses are included. The contents have been well arranged, and in appearance and general "get up," as well as in subject-matter, the book is to be commended.

* The 1941 edition of *The Municipal Year Book and Encyclopaedia of Local Government Administration*, published by the *Municipal Journal*, Ltd., 3/4, Clement's Inn, London, W.C. 2, price 40s. 0d. net; comprising over 1,400 pp., divided into 49 sectional classifications, with comprehensive indices.

ALTERNATIVE SOURCES OF POWER ON GAS-WORKS —PEACETIME AND WARTIME*

By P. SUMNER (St. Helens)

At least 90% of the gas undertakings in the country are dependent on steam as the driving force for their exhausters. The steam is generated at either (*a*) a central boiler installation in the works, or (*b*) waste heat boiler installations situated in the retort house, with a central Lancashire boiler or similar installation as make-up or stand-by.

Here we come to the question of stand-by. Even in peacetime no well-run works would entirely dispense with the services of a solid fuel-fired boiler installation even though the whole of the works' steam requirements could be met by the waste heat boilers.

The highly efficient waste heat boiler, by reason of its construction and method of operation, is more liable to develop trouble than is a Lancashire or Cornish boiler. In the case of a moderate-sized waste heat installation the failure of a boiler tube, a fan turbine, or a fan motor, would mean—generally without a moment's notice—that the works would lose an hourly supply of 6,000 lb. to 8,000 lb. or more of steam.

In this event the only thing to be done is to shut down all non-essential units until such time as the demand can be met by the solid-fired installation. Though the whole of the steam demand on the works is met by the waste heat plant, a certain proportion of the solid fuel installation should be kept under easy steaming as a stand-by against the possibility of any waste heat units suddenly failing. Here, then, we have our first alternative; this can easily be worked up to capacity to keep essential plant such as exhausters, &c., going.

Another factor creeps in, "the steam range." Even when we have two steam-raising units in operation, waste heat and solid fuel, one assisting the other, it is general practice that both these should feed into a common steam main. If for some reason one or other fails or due to enemy action one is put out of commission, each could be isolated, but if we have the main steam line damaged we have our main artery severed, with all its complications.

A steam line is not a very vulnerable object, but it must be pointed out that it is usually carried overhead and often fastened to buildings and carried by wall brackets. While the pipe itself does not present a large target, it is possible for it to be put out of order by the collapse of its supporting building or nearby objects falling on to it. A damaged steam pipe in itself is not a serious matter, and can be easily repaired if the following points are kept in mind: Is the correct size of steam pipe kept in stock? Is the stock in order? Are the right flanges available? Have you got spare valves? Have you available machinery for easily cutting and screwing the pipe?

These are only small things, but they can be so very easily overlooked. If they are in order and the steam range has been well planned, and the works is served by a ring main, or there is an alternative route by which steam can be passed to almost every unit, then there should be little cause for worry from this source. The planning and laying out of steam lines is not a subject which has received the fullest attention, and often it is a case of simply running a pipe line without further thought of complications to be met if a temporary line repair or extension should be necessary at some future date.

On all gas-works there are certain units which are without question specially adapted for steam drives. I refer to the various tar and liquor pumps which are an integral part of every gas-works. These are as far as possible concentrated at one point in the vicinity of tar and liquor wells, but it is not unusual to find also quite a number of pumps at scattered points in the works doing one sort of job or another.

There are a number of points on most gas-works which are dependent on steam for their power. To what extent the works would be disorganized or crippled if the source of steam were cut off or if the line to that particular unit were damaged is a matter for individual assessment.

The direct use of steam is economical for power purposes when the exhaust can be used for process work. This suggests itself in the form of heating water prior to the softening process or feed water heating. The steaming of vertical retorts and chambers, steam for sulphate of ammonia production, heating of buildings, evaporators (gas drying plant), &c., can all be operated from exhaust from fan turbines and gas pressure raising engines. The warming of purifier boxes to assist the reaction also suggests itself a method of utilizing exhaust steam.

All these processes can use exhaust steam from any direct steam-driven engine if precautions are taken not to throw back pressure on to the engine. Specially designed engines capable of running with a back pressure are available at an increased cost, which I think is justified.

In utilizing exhaust steam, especially for process work, care should be taken that it is freed from oil. Turbines are preferable to reciprocating engines in this respect. The collection of all condensate from steam exhausts makes a valuable contribution to the feed water supply to the boilers. Here, of course, it must be entirely oil free.

Again turning to the point of direct use of steam or otherwise, it very often boils down to attempting to meet altered conditions —*i.e.*, growth of plant at scattered points needing power drive, or facing up to a comprehensive scheme of modernization. Often, in order to meet growing requirements, small engines, either steam or gas, were put down. These were associated with rather complicated layouts of shafts and countershafts for the purpose of grouping—*e.g.*, driving an elevator and also a conveyor from one engine through counter-shafting. Where these additions took the form of steam engines supplied from an existing system, the efficiency was prejudiced by the transmission losses in the steam distribution system, together with those losses which are inseparable from the use of small steam engines. These small engines were often placed in the most unsuitable positions from the point of view of efficiency and fed from arterial mains running through passages or across open spaces, and it is most difficult to form a balance-sheet of losses from a number of engines thus placed. There is no doubt, however, there are considerable losses.

Because these engines were placed at scattered points, the use of simple non-condensing engines was enforced, these consuming from 20–50% more steam than condensing engines. In some instances, when the necessity for additions arose, gas engines were installed. The installation costs as against steam engines were very little different and running cost very much less than the simple steam engine. The main reasons for the more general adoption of the steam engine are: (*a*) greater flexibility of speed regulation, and (*b*) a reserve of steam power. It was not until increases in the quantity of steam required began to tax the capacity of boiler plant and/or mounting fuel charges began to shout that the problem had to be faced.

Discussion

Mr. **A. E. Simpson** (Macclesfield) said that at one time he was associated with a generating plant which was run on back pressure. There was a very heavy load during the day, when a coal conveyor plant and four workshops were supplied with current. At night the load was considerably reduced, and in consequence the generator was working considerably under its capacity for 75% of the 24 hours. He was, therefore, of the opinion that back-pressure plant on a generator was extravagant, since a considerable quantity of steam was taken up.

Mr. **T. Reynolds** (Stockport) said that the works at Stockport was practically dependent upon motors for driving conveyors and extractors, and visualizing this position, he had instructed his mechanical engineer to purchase all the second-hand motors he could, including gear boxes. The gear box was converted to a friction drive and the motors sleeved and rebored. C.C.L. carburetters were purchased and the motors were converted to gas engine drive. Castings were made from the driving wheel which would take "Vee" belts, and a split pulley was bolted on to the half coupling of the motor. This arrangement had proved to be a most economical standby for emergency purposes.

Mr. **R. Walker** (Manchester) remarked that the whole question merited detailed investigation, particularly with regard to the quantity of steam which could be efficiently used for the generation of power. Could the Author state the amount of steam required for the general type of reciprocating engine? If proper attention was not given to the conditions of running—*viz.*, the load factor and the question of the cut-off engine, or the steam trap—so as to get the most efficient conditions of steam engine operation in a power house, then the quantity of steam used per unit could vary from 30 to 80 lb. On a big load there would soon be a serious increase in the fuel bill.

Mr. **W. H. Battersby** (Bury) stated that he was using very fine breeze (through ¼ in. mesh) for the boiler, and he was producing steam very cheaply. Bury was one of the first gas-works to place an order for generator plant, and for the past 33 years, he could confidently

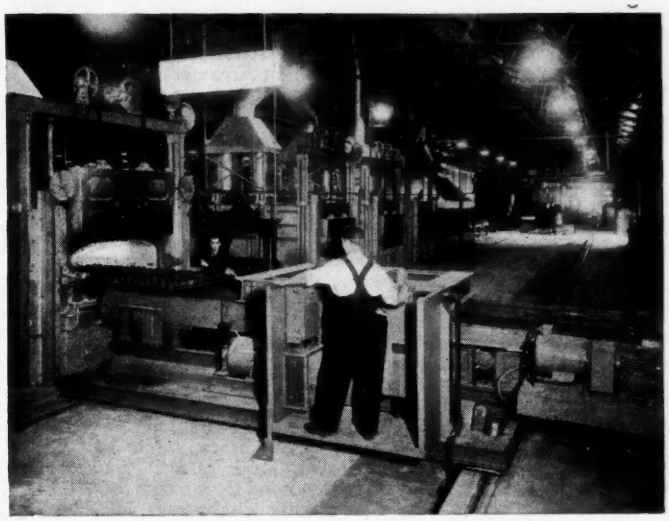
* From a paper to the Manchester and District Junior Gas Association.

assert, electricity had served them very well. Electricity could be advantageously used for pumps, for the day of the steam pump had passed, especially where the pump was a distance away from the steam range. He was of the opinion that the lay-out of steam mains was an expert's job. He favoured the old-fashioned Lancashire and Tonge steam trap.

Mr. **F. Cartledge** (Oldham) said that at Higginshaw Works, D.C. was generated by means of 325 kw. sets, driven by Ashworth and Parkers' engines. The steam was passed out through high and low pressure cylinders, and the arrangement was proving very economical. When there was a demand for process steam, it was passed out. When the Higginshaw Works was designed, a Jeffrey coal crusher was obtained, which was driven by a 40 h.p. motor rope driven. It had been very little used and a 70 h.p. D.C. motor was obtained and fixed alongside. An outside source of A.C. had to be brought in for the purpose of making conversion in case of necessity. About 60 kw. were obtained for the motor, and if the routine practice at the works was adjusted, the electrical plant was sufficient to meet the requirements of the coal handling plant and boilers. A standby supply of current could easily be obtained where there was available a large motor and alternating current.

The **President** remarked that his view was always to have available alternative sources of power, but it should be borne in mind that what was most efficient in one works might not be so in another.

Heat Treatment of Forgings



THE problems involved in handling a variety of components, on a large production scale, through the hardening and tempering cycle are considerable and have been tackled in many ways.

For smaller articles, when the time required for heating is not unduly long, a continuous type furnace, of either mesh belt, roller hearth, pusher, walking beam, rotary, or other type may be used for the hardening portion of the cycle. The parts can be directly dropped into the quenching medium and then lifted out periodically by means of a basket. Alternatively, automatic conveyors have been designed for the continuous removal of quenched articles from the tank, from which they can be directly transferred to a tempering furnace, which may also be of a continuous type.

When the heating cycle is a long one, continuous furnaces are somewhat at a disadvantage, as their dimensions would necessarily be of unwieldy proportions to permit an output figure consistent with economic operating conditions. Other considerations make it advisable to revert to the use of batch type furnaces, which, when operated under correct conditions, give very uniform results and leave little to be desired in regard to either quality or quantity of production.

Our illustration shows a general view of a complete heat treatment installation by the Incandescent Heat Coy., Ltd., Cornwall Road, Smethwick, in which batch type furnaces and mechanically operated charging and quenching equipment have been used to the best advantage. Each furnace has a capacity of approximately one ton per charge of forgings weighing from a few pounds up to several hundredweights.

The bulk of forgings require a 2–3 hour soak at temperatures varying from 850°–910°C., followed by an oil quench. In some cases, normalizing for two hours is carried out. The forgings are tempered at 600°C., and facilities are provided for water quenching if required.

As rapid handling of the load is an essential feature if the furnaces are to be continuously maintained in production, a high-speed electrically operated charging machine is provided. A ton load of forgings is completely charged or discharged in 5 seconds, and the load may be rapidly transported from the furnace to the nearest quenching tank as the machine has a maximum traversing speed of 250 ft. per minute when fully loaded.

The complete plant consists of a battery of five batch type heat treatment furnaces together with four oil quenching tanks and one water quenching tank, three loading and a like number of unloading racks, and a specially designed electrically operated high speed charging machine.

Design of Furnaces

The five furnaces used are all of the Patent Incandescent deep recuperative under-fired natural draught type, having clear inside working dimensions 10 ft. long by 5 ft. wide by 2 ft. high. These furnaces are fired by burners of the inspirating type which fire into individual chambers below the hearth. Pre-heated secondary air is employed so that complete combustion takes place before the gases enter the furnace proper. The gases travel through vertical regulable uptakes on each side of the furnace, and are finally withdrawn to waste gas flues near the door opening and then travel through deep recuperators built below the hearth. It is through these recuperators that the incoming secondary air is heated.

Counterbalanced doors operated by geared hoisting tackle provide easy opening and closing of the furnace door. In addition to the refractory lining, the side walls are heavily insulated, minimizing heat losses. Each furnace is automatically controlled, the controlling equipment being situated on the rear wall.

A central control panel carries five indicating pyrometers, whereby the temperature of each furnace can be seen at a glance, while a multipoint recording pyrometer provides a continuous record of the temperature of each furnace.

Charging Equipment

An interesting feature of the installation is the electrically operated charging machine which travels along the entire length of the plant on rails. The load is placed on landing walls inside the chamber, the charging forks withdrawn, and the door closed.

For unloading and quenching this cycle is reversed; the forks run into the furnace between the hearth piers, the load is raised, withdrawn, and rapidly conveyed to a quenching tank, where the work is transferred on to a table constructed of steel sections corresponding to the loading walls of the furnace hearth. An overhead drum gear operates the table and lowers the load smoothly and quickly into the oil.

The charging forks have a total reach of 12 ft., and carry an evenly distributed load of one ton of forgings. Although large forgings may be placed directly on to the loading tables (which are constructed of 9 in. by 4 in. steel joists spaced similarly to the landing piers of the furnace hearth and quenching tank equipment) and then transferred by the charging machine as required, smaller parts have to be loaded on to perforated trays, preferably made of nickel chrome alloy.

The "IN" and "OUT" motion of the forks is by means of two endless chains running over sprockets driven by motor and reduction gear; the control is arranged for operation by an automatic electric push-button starter from the driving platform in conjunction with limit switches and an electrically operated brake on the motor shaft to prevent over-running.

The lifting action of the carriage runway is by means of toggle levers operated from a motor through reduction gear and crank. This results in continuous rotation of the motor being maintained, the "UP" and "DOWN" positions being controlled by limit switches and an electro-mechanical brake.

The toggle levers in the vertical position provide a mechanical lock to relieve the brake load. The carriage is controlled by four guide rollers to give perfect alignment during its operation. The machine traverse is effected by a variable speed drum control driven by a motor through reduction gear. The controller is fitted with a conventional type dead man operating handle as an approved safety device. A maximum running speed of 250 ft. per minute can be obtained, and it has actually been found possible to quench a load from the furnace most distant from the nearest oil tank in a time of 21 seconds.

The quenching tanks are 12 ft. long by 6 ft. wide by 8 ft. deep and have side extensions and splash plates to run off the overflow. Each tank has a capacity of 15 tons (3,500 gallons) of oil, which gives ample quenching column for the load.

The charge is raised and lowered on its rack by means of wire rope suspension from overhead drums driven by motor reduction gear and chain gearing. The movement is push-button controlled in conjunction with limit switches.

Excessive heating of the oil is provided against by means of oil coolers through which the oil is continuously circulated. Hoods are provided over the oil tanks, and fumes are withdrawn by fan exhausts located inside the ducting leading from these hoods.

The method of lowering the forgings into the oil in a fixed time has the advantage that during the whole of the lowering time fresh oil is being constantly brought into contact with the load, not only by the convection currents set up during cooling, but also by the steady mechanical motion of the work through the oil. In this way a very uniform cooling rate is attainable.

If necessary, the load can be given a reciprocal motion up and down through the oil after it has reached its lowest point in the quenching tank by suitably manipulating the control buttons.

HOW FAR IS THE PROXIMATE ANALYSIS A RELIABLE GUIDE TO COAL BEHAVIOUR?*

By J. G. BENNETT, *Director, British Coal Utilization Research Association*

(*Continued from p. 148*)

Reactivity

The next property to be considered is ease of ignition. Generally speaking, with coals over 20% volatile matter, differences in the ease of ignition have little practical importance, and we are therefore concerned as regards this characteristic with the low volatile range. Here the case of ignition turns out to be a composite property dependent upon at least four factors:

(*a*) The decomposition temperature—*i.e.*, the temperature at which the fuel begins to disengage combustible gases.
(*b*) The rate at which combustible gases are evolved.
(*c*) The total amount of combustible gases evolved.
(*d*) The ease with which the residual carbonized substance reacts with oxygen.

Of these, only the third is directly dependent upon the volatile content, and, in fact, many unexpected results are observed when ignitability is assumed to depend upon the volatiles alone.

A few years ago, in the course of an investigation on behalf of the Monmouthshire and South Wales Coal Owners into the use of low volatile coals in open fires, it was found that ease of ignition did not by any means correspond with volatile content.(6) It has more recently been found that the ease with which anthracite can be started up in portable gas producers could not be predicted from their proximate analysis. An investigation in progress into fuel reactivity shows that this is essentially a property of the carbon structure and not of the amount of volatiles released on decomposition. Although in low rank coals the the two properties run parallel to a great extent, this is by no means the case with high rank Welsh coals. Table II shows how the reactivity of six different anthracites,(7) as determined by their heat of wetting with methyl alcohol, failed to agree with their volatile content.

TABLE II.—Reactivities and Volatile Contents of Anthracite Duffs.

Anthracite Sample No.	Volatile matter % (dry basis).	Reactivity by heat of wetting in methyl alcohol (cal/g).
1	6.7	7.2
2	7.0	7.5
3	7.5	5.4
4	8.4	6.8
5	8.7	3.4
6	9.1	5.6

Coking, Caking, and Thermal Decomposition

We must now pass to properties of coal which have such different importance for hand-firing and mechanical stoking—namely, the swelling and caking characteristics which make their appearance at about 40% volatiles and continue down to 12% or thereabouts. The broad distinction between caking and free-burning coals has always been known to firemen, whose experience teaches them to build the fuel bed differently to allow for these effects. These differences, however, are not such as to make the difference between success and failure in operation. Scotch marine boilers are regularly fired with coals having every conceivable degree of caking and swelling characteristics. Non-coking Welsh coals and highly coking Durham coals are both excellent bunker fuels, and so are Scottish and Northumberland coals, which lie between the two. A marine superintendent purchasing bunker coals for hand-fired Scotch boilers is very little concerned with the volatile content, and he certainly does not require to know it with any degree of accuracy. The same applies to a great extent to hand-fired Lancashire or vertical boilers.

It is with the transition from hand-firing to mechanical stoking that swelling and caking characteristics assume importance. With some mechanical stokers, relatively small differences in these properties can make the whole difference between success and failure. Others, though more catholic in their tastes, require special adjustment for each change in the coal supply if the best results are to be obtained. With gas producers, the position is somewhat different, since hand-fired gas producers have always been sensitive to the characteristics of the coal, and it is claimed that mechanically operated gas machines can handle successfully a wider range of fuel supplies.

* Paper to the Institute of Fuel, April 3.

I think that our discussion to-day concerns primarily the selection of coals for boiler firing and more particularly smaller boilers used in central heating. I do not propose, therefore, to discuss carbonization problems and the value or lack of value of the proximate analysis for determining the suitability of coals for gas or coke manufacture, beyond saying that for many years past the gas and coke oven industries have largely abandoned the proximate analysis in favour of special tests, such as the Gray-King assay for the estimation of tar and gas yield and the Sheffield and other coking tests to determine the quality of coke.

We must now ask ourselves more precisely what it is that we mean when we speak of the swelling and caking tendencies of bituminous coal. Some carbonaceous materials, when heated, first melt and then decompose, while others decompose before melting. Some coals belong to the first class, others to the second. The melting temperature and the decomposition temperature are so close to one another in bituminous coals (see fig. 5) that true melting is never observed, and it is better to speak of softening or a plastic stage. Decomposition takes place over a wide range of temperatures starting with the evolution of water vapour, carbon dioxide and monoxide, followed by paraffins and other hydrocarbons mixed with phenols and bases and ending at very high temperatures with hydrogen. Many organic substances when heated show a similar complex behaviour, but in none has this behaviour the same practical importance as it has with coal. The formation of a coke as opposed to a "char" lacking the characteristic cellular structure depends upon a certain sequence of softening, decomposition and solidification. According to this sequence and upon the speed and intensity of its various stages, different coals swell without softening, soften without swelling, form hard cokes, weak cokes, swollen cokes, contracted cokes, and exhibit a whole variety of intermediate features, every one of which may have the utmost importance if the control of combustion depends upon a mechanical device and not upon the intelligent observation of a trained fireman.

All these are differential effects—that is to say, they do not depend upon one basic property of the coal, but on differences between two basic properties, more precisely the difference between the tendency to decompose on heating and the tendency to soften. With change in rank which can roughly be measured by change in volatile content, the two basic properties will change progressively by stages which will not necessarily coincide. From this, it follows that there are likely to be regions where

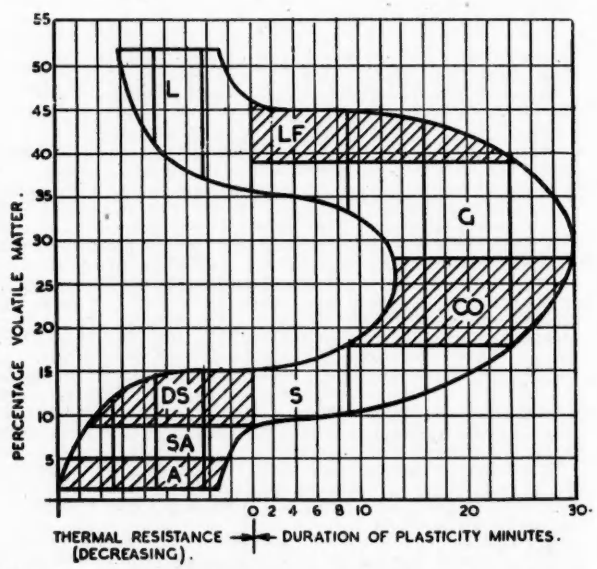


FIG. 2.—*Relation of Plastic Properties to Volatile Content. The band is divided into eight classes of coal as follows: A, Anthracite; SA, Semi-anthracite; DS, Dry Steam Coals; S, Steam Coals; Co, Coking Coals; G, Gas Coals; LF, Long Flame Coals; L, Lignites.*

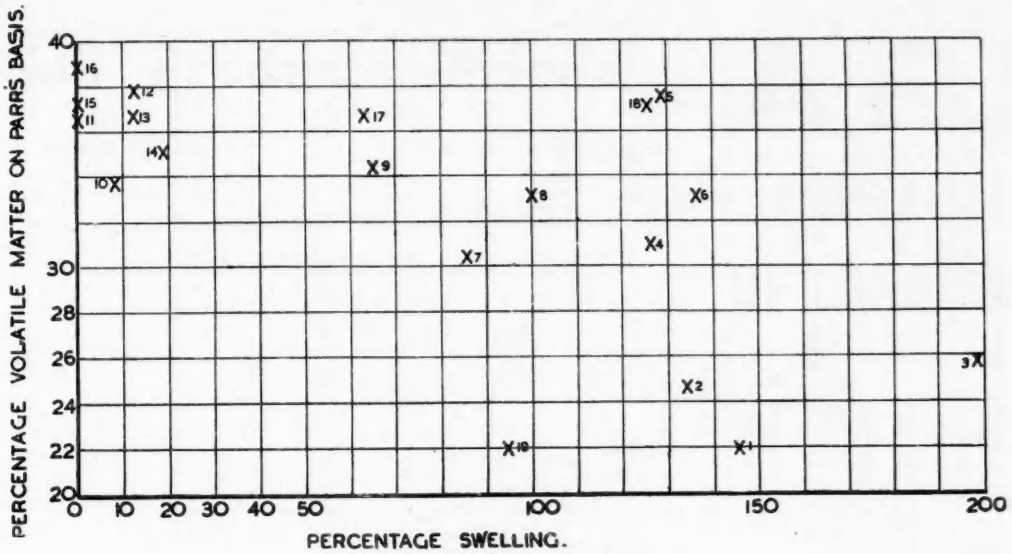


FIG. 3.—*Sheffield Swelling Index.*

very small changes in the basic properties (which can be related to the volatile content) will cause profound changes in the secondary properties which depend upon differences only. This is precisely what we do observe in fact. Over certain ranges the swelling and caking characteristics of coal can be predicted with reasonable accuracy from the volatile content. In other ranges no such prediction is possible.

Many attempts have been made in recent years to determine separately the tendency of coal to soften and to decompose. It would go far beyond the scope of our present discussion to consider all these various attempts in detail, but we may take as typical a recent Russian publication which attempted to show on a single chart the way different coals behave on heating. This graph, which is due to Matyushenko,[8] is reproduced in fig. 2.

In this diagram the behaviour of coal on heating is shown in relation to the volatile content. Coals to the right of the zero point go through a plastic stage which in the particular apparatus used lasts for a certain time under the given conditions of heating. The duration of plasticity is a measure of the relation between fluidity and decomposition. To the left of the zero point coals do not become plastic but exhibit one or another form of thermal deformation, swelling, cohesion due to softening at the surface, decrepitation, and loss of mechanical strength.

I have tried to fit British coals into Matyushenko's diagram without much success, and I have only reproduced it in order to draw conclusions nearly opposite to those reached by the Author. He suggests that his diagram enables the industrial behaviour of coals to be predicted from their proximate analysis, whereas it is quite obvious that, if his diagram is correct, two coals with the same volatile content may behave quite differently. Thus the horizontal line at 13% volatile includes non-softening coals, coals which swell without becoming plastic, and coals which become plastic to a marked degree. On the other hand, a degree of plasticity of 16 minutes' duration is exhibited by coals from 13 to 43% volatiles.

It is obvious from these examples that however interesting diagrams of this sort may be in showing the general changes which coals undergo as they increase in rank, they have little or no value at all in helping us to predict the behaviour of coals from their proximate analyses. This absence of correlation between volatile content and thermal decomposition and the swelling and caking properties of coal is further shown in some diagrams which have been kindly prepared for me by my assistant, Mr. Hawksley. Fig. 3 shows the relation between volatile content and the swelling of coal by the Sheffield swelling test.[9]

I would like to draw your attention particularly to the range of 34 to 38% volatile matter within which different coals show variations from 0 to 120% in their degree of swelling.

The next figure (4) gives the temperature at which coals begin to soften by the Foxwell test for the beginning of the plastic range. Here I would like to refer you particularly to the range 28 to 30% volatile, where the onset of plasticity varies from 360° to 415°C.

To complete this series we can consider a very interesting paper published three years ago by Evans and Phelps[10] in which they reported measurements of the decomposition temperatures of various coals.

Seyler has supplemented their work by determining the softening-points for a similar range of coals taking temperatures of equal fluidity as an index of softening. He has very kindly communicated these results to me in the form of the diagram, fig. 5, in which the crosses represent Evans and Phelps's results for decomposition temperatures, and the circles Seyler's data for softening.

You will see from these that the two properties follow quite different curves. Whereas the softening temperature shows a distinct minimum in the region of 32% volatile, the decomposition temperature progressively increases with falling volatile content.

The main conclusion which I wish to draw from these curves concerns the observed behaviour of coal on heating. This is a differential effect dependent not so much on the absolute value of either the softening or the decomposition temperatures as upon their difference. If you appreciate this you will readily see why there is so much uncertainty in the region from 30 to 40% volatile matter.

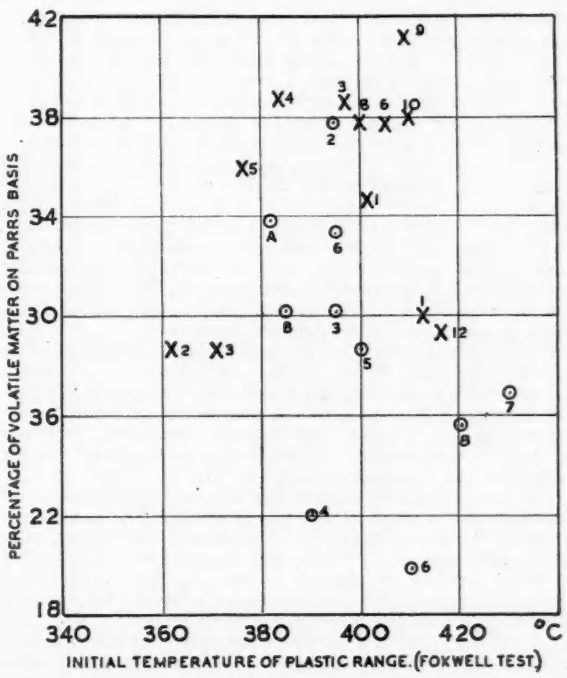


FIG. 4.—*Relation of Softening Temperature to Volatile.*

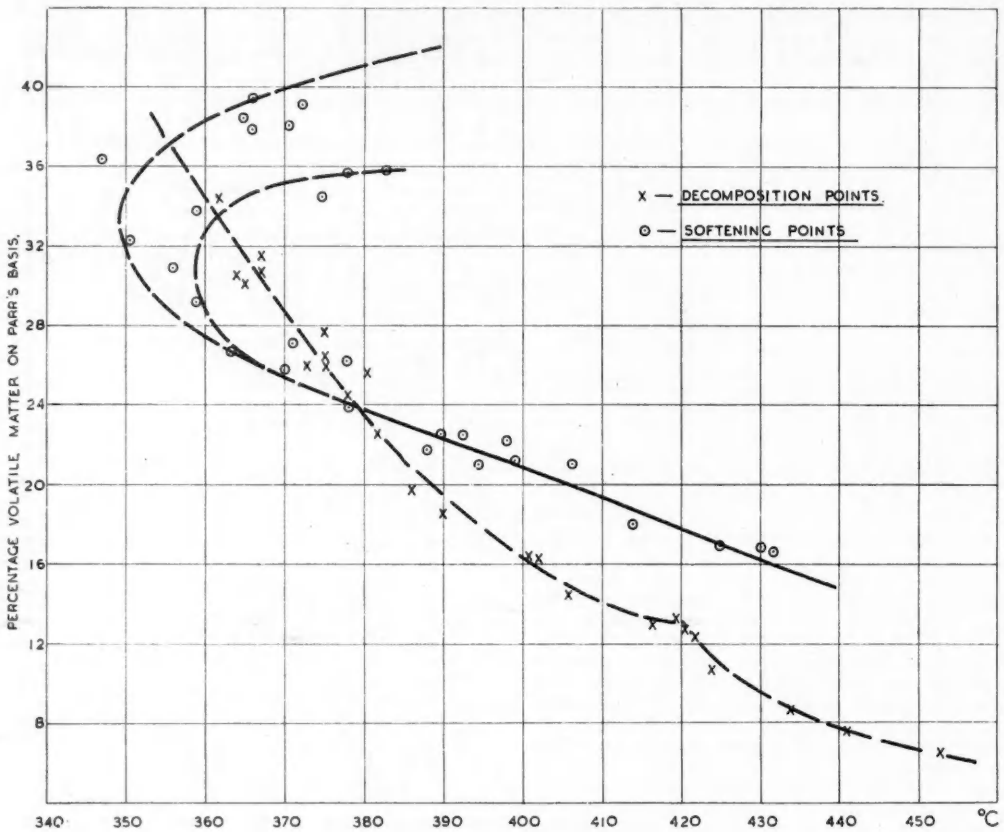


FIG. 5.—*Decomposition and Softening Temperatures.*

If we turn to the higher rank coals, we find that there is no softening at the temperatures for which this effect appears for bituminous coal, but in the fuel bed, where much higher temperatures are encountered, even the slightest tendency to soften may have a marked influence upon the behaviour of the fuel. Steam coals below about 12% volatile are used in gravity feed appliances, but unless carefully selected, those near the upper limit are liable to give trouble through cohering of the particles. At this point, in fact, we see the onset of softening resulting in cementation of the particles without actual fusion. Table III, which has kindly been communicated to me by Dr. Seyler, summarizes the coking properties of nearly three hundred samples of Welsh steam coal grouped into seven coking classes.

It will be seen that in the group 12 to 13% volatile there is a broad spread of caking properties, from absence of all caking to caking plus swelling. The peculiar property of swelling without softening is almost entirely confined to the narrow range of 13 to 15% volatile. It is clear that having regard to the errors in sampling and analysis to which I have already referred, the prediction of this particular swelling property from the proximate analysis would be highly dangerous, and the only safe course is to observe and specify this property separately.

I think that you will find the best confirmation of the views I have been putting forward in fig. 6, which shows the connexion between the agglutinating power and the volatile content. The various agglutinating tests in general use are derived from the method proposed by Campredon and subsequently improved by various workers until it was finally standardized by the British Standards Institution in B.S.S.705.

The test consists in determining the maximum quantity of inert material—a sand of carefully controlled characteristics—which will form a coherent lump when heated with unit quantity of the coal under test. The test itself has been severely criticized by many workers on account of the difficulty of obtaining consistent results by different workers and different laboratories. Nevertheless, allowing for a considerable margin of error, the sand test does give a measure of the extent to which a coal becomes fluid before it decomposes. It is thus a typical differential effect dependent upon the decomposition and you can see how wide the variations are.

With the material in front of us, we can attempt to draw some conclusions as to the range of volatile contents within which the behaviour of coal can be reasonably well predicted and those for which prediction is unsafe. Before we can do this, however, we shall have to consider some disturbing factors which further complicate the problem.

Disturbing Factors

So far we have taken coals as forming a continuous sequence from low to high rank, and have tacitly assumed that the volatile content, if accurately determined, can be regarded as a measure of rank. This assumption is, unfortunately, not justified. Coal contains at least three different constituents—vitrain, durain, and fusain—which have different volatile contents for the same rank. These constituents were first pointed out by Stopes nearly 30 years ago as the visible banded constituents of bituminous coal. Since then the Stopes classification has proved invaluable for interpreting the properties and behaviour of coal. Seyler has shown that the petrological constituents must be distinguished before any correlation can be made between proximate and ultimate analysis, and it follows that this distinction is also necessary before any reliable prediction of behaviour from proximate analysis is possible. I do not propose to discuss this in detail, but would refer you to Seyler's Gold Medal Papers to the South Wales Institute of Engineers([17]), from which you will see that he shows that for any given coal the volatile content of the durain and the vitrain are different. The volatile content of durain is always higher than that of vitrain for coals from the same place and seam. Whereas the volatile content of a pure vitrain can be calculated without much error from the ultimate analysis by the formula:

$$V = 10.6\,H - 1.24\,C + 84.15 \quad . \quad . \quad . \quad (1)$$

this formula must, for durain, be replaced by—

$$V = 10.6\,H - 1.24\,C + 84.15 + \delta v \quad . \quad . \quad (2)$$

δv is called by Seyler the "volatile displacement," and its amount for various durains is given in Table III.

(To be concluded)

Gas Products Prices

The London Market

April 28.

Prices of Tar Products in the London market remain unchanged. They are to-day as follows: Pitch is nominal; creosote is 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure Toluole under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha, 2s. 4d. to 2s. 6d., and 90/160 pyridine about 13s. 6d., all per gallon naked; refined crystal naphthalene is £23 per ton in bags; all prices are *ex* Makers' Works.

The Provinces

April 28.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 10d. to 11d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha North, 1s. 6d. to 1s. 7½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4½d. to 4¾d.; Scotland, 4¼d. to 4¾d.; low gravity, 4½d. to 4¾d. Fuel Grade, 4d. to 4¼d. Carbolic acid, 60's, 3s. 7½d. to 3s. 9d. Naphthalene, £12 to £15. Salts, 70s. to 80s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, April 26.

A steady demand continues for most products but, on the whole, prices are unaffected.

Refined tar shows no alteration at 4½d. to 4¾d. per gallon in the home market and 3¼d. to 3½d. per gallon for export, both f.o.r. naked.

Creosote oil is in good request with prices not lower than the following: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6¼d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid: This product in all qualities continues active, with prices firmer as follows: Pale, 99/100%, 2s. 6d. to 2s. 8d. per gallon; Pale, 97/99%, 2s. 3d. to 2s. 5d. per gallon; Dark, 97/99%, 2s. to 2s. 2d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha: Supplies as available are changing hands at round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha: 90/160 grade in 1s. 8½d. to 1s. 9d. per gallon and 90/190 heavy naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridines are nominal at round 15s. per gallon for 90/160 grade and 17s. per gallon for 90/140 grade.

Associated Gas & Water Undertakings, Ltd.

The Directors of Associated Gas & Water Undertakings, Ltd., announce that they are recommending at the forthcoming Annual General Meeting a Final Dividend on the Ordinary Shares of 2½% actual (6d. per share) less Income Tax at 10s. in the £, making with the Interim Dividend already paid, 5% for the year ended March 31, 1941 (same).

Gas Stocks and Shares

Markets fluctuated from day to day last week, the news bringing with it a reactionary tendency, while sentiment was strong enough at times to stage a recovery. British Funds were no exception although on the week prices were well maintained. War Loan 3½% was quoted *ex div.* on Friday and opened at 102¾ against the overnight price of 104⅜—2½% Consols closed without change at 77¼. Apart from a few bright features among the junior stocks home rails generally were dull. There were no special features in the industrial section and any price changes were within narrow limits. Oil shares were quiet and irregular, and rubbers and teas remained idle and dull.

There was a little more business done in the Gas Market last week though price changes on the whole continued to move downwards. Gas Light units were better supported and the price closed unchanged, but several of the Companys' fixed-interest stocks reacted. A few transactions were also recorded in South Metropolitan ordinary, the quotation however dropping a further 2 points, and Tottenham stock also received some support.

At the postponed Annual General Meeting of the Gas Light & Coke Company held last week it was decided not to pay any further dividends on the preference, ordinary and maximum stocks for the half-year to December last. Similar action was taken by the proprietors of the Commercial Gas Company with regard to its preference and ordinary dividends covering the same period.

The Directors of the Montevideo Gas and Dry Dock Company have declared a final dividend for 1940 of 3% free of tax—2% payable on May 21 and 1% on December 1 this year—again making 4% free of tax for the year.

The Associated Gas and Water with a final of 2½%, and the South Western Gas and Water a final of 3%, are maintaining their previous year's distribution of 5% each.

The following were the price changes during the week:

OFFICIAL LIST

British Ord.	65—75	−5
Gas Light & Coke, 3½ p.c. max	35—40	−3
,, 4 p.c. Pref.	59—64	−2
,, 3¾ p.c. Red. Pref. ...	65—70	−3
,, 3 p.c. Deb.	65—75	−5½
,, 3½ p.c. Red. Deb. ...	80—85	+1
South Metropolitan Ord.	33—38	−2

SUPPLEMENTARY LIST

North Middlesex, 5 p.c. Pref. (x.d.) ...	87—92, April 21	

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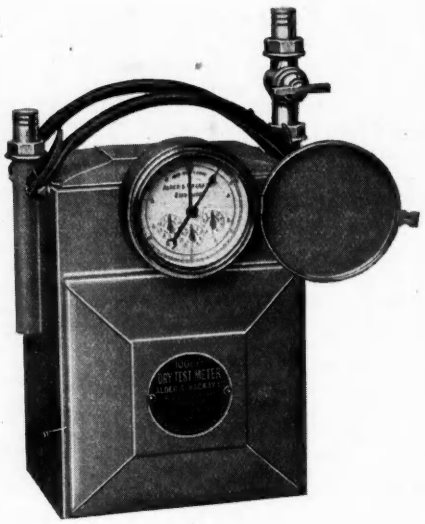
En passant

Sweet are the uses of adversity;
Which, like the toad, ugly and venomous,
wears yet a precious jewel in its head.
Shakespeare (As You Like It).

Illustration shows A. & M. Dry Test Meter. These are made in 40, 100 and 200 c.ft. sizes. The pointer shows the hourly rate by a minute's observation on the outer circle and 1 c.ft. in 100th parts on the inner.



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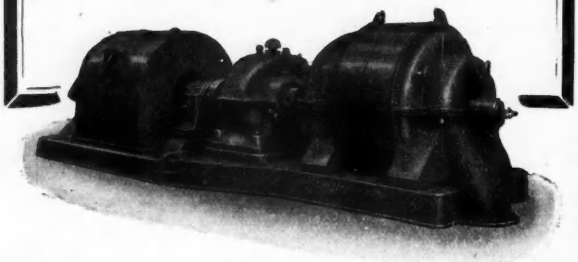

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